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PATROL PLANNING IN THE ROTTERDAM POLICE DEPARTMENT

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ABSTRACT

A detailed analysis leading to the development of a specialized police department planning section has resulted in an improved patrol operation for Rotterdam, based on Larson's travel time model combined with a three-priority queuing model, and the prospect of improved police dispatching and patrol allocation for other cities in the Netherlands.

BACKGROUND AND INCEPTION

Over the last three years the Rotterdam, Netherlands, Police Department has been engaged in a detailed study to analyze and improve its patrol operation. The effort has resulted in a patrol plan soon to become operational city-wide. The new plan is based on a combination of the travel time model developed by Larson (1972:78-100) and a three-priority queuing model employed by many United States departments. A recent evaluation of the Rotterdam system indicates that it has been a well-conceived and carefully tested approach to the problem of determining the number of patrol units required to adequately answer calls for service. Of particular interest is that the two primary planners on the project were chosen within the department and had no previous exposure to planning techniques or operations research. The progress made in a relatively short time period is a credit to the team and is an experience from which many departments in this country could greatly benefit.

In terms of the planning function within a department, the police in the Netherlands have lagged far behind departments in the United States. Perhaps one reason for this is that the crime rate in the cities of Holland is so much lower than American cities that the requirement for a planning unit never appeared to be justified. Rotterdam has a population

of approximately 750,000 and is serviced by a police department having 1,300 officers. An indication of the volume of calls is that only two dispatchers are required during peak call-for-service periods in the city and there are generally about twenty patrol units city-wide (there are, however, a large number of foot patrolmen). On the other hand, there is evidence that crimes and calls are increasing throughout the Netherlands.

Rotterdam became the first major city in the Netherlands to establish a Planning Section in its police department. The section was started in 1971 under the field operations branch with the appointment of Inspector J. H. Karel and Chief Inspector J. van der Meer as full-time planners. Their first assignment was to study the patrol allocation problem. The basic car beat plan had not been changed for at least twenty years and a complete lack of detailed information existed. As a result, the smallest geographic area for which crime summaries were available was the Police District (of which there are seven) and no data were available on the distribution of calls for service. An additional complication was that no police department in the Netherlands had ever established a data processing system.

As an initial step, the planning team began to accumulate reports and studies on patrol allocation from other countries.[1] The queuing models[2] used by some departments in the United States and the travel time model developed by Larson seemed particularly applicable to the Rotterdam environment. It is again noteworthy to mention that the two planners had no previous exposure to the subject of operations research. Both spent considerable time reviewing mathematics and were able to overcome this obstacle.

The planners also contacted the SOAG bureau, a computer center completely devoted to Rotterdam government activities. Similar centers exist throughout the Netherlands. The result was the establishment of a police planning system called APIS having as its base a data file management system called AIV. There are presently three inputs to AIV—Dispatch Tickets ("Meldkamer" cards), traffic accident reports, and crime reports. A Meldkamer card is completed by the dispatcher on each citizen call for service and includes the location, date, unit assigned, time dispatched, time arrived, time completed, and type of call. The Meldkamer computer file is the input to an APIS Planning Module which (1) forecasts the number of calls for service in a given geographic area using a version of exponential smoothing, (2) employs a queuing model to calculate the probability of delay and the average waiting time of a call, and (3) uses Larson's travel time model to estimate travel time within the patrol area.

In queuing theory terminology the queuing model is a multiserver three-priority model with no preemption and first-come, first-served dispatching (by priority).[3] The term "no preemption" means that patrol units are not interrupted on a call of low priority to respond to a call of higher priority. In Rotterdam this is only an approximation since the planners have recently implemented a limited preemption policy which was motivated in large part by simulation analyses[4] that displayed the response time reduction benefits of preemption. The travel time model is basically the relationship developed by Larson (1972, eq. 3.38) to estimate the average travel time, denoted by Ti (N), for a patrol vehicle to reach the location of a call for service of priority i given N available units:

$$T_i(N) \approx \frac{2}{3v_i}\sqrt{\frac{A}{N}}(1 + \rho)$$

where

v_i = Effective response speed to priority i calls
A = Area

λ = Arrival rate of calls
μ = Service rate of calls
N = Number of patrol units
$\rho = \frac{\lambda}{N\mu}$ (average unit utilization)

Performance norms are set by policy decision; a typical set is as follows:

Norm	*Priority* 1	2	3
Average driving time to a call (minutes)	3	8	12
Average waiting time before responding to a call (minutes)	1	3	30
Probability a call will have to wait before being serviced (%)	5	10	20
Average Unit Utilization	between 30% and 45%		

Based on its forecast the APIS Planning Module calculates the number of units necessary to satisfy each norm category and the maximum required for any of the norms is the actual number required.

There have been two operational experiments in Rotterdam with the APIS Planning Module. The first covered the period between June and December 1973. This experiment combined two districts between the hours of 2200 and 0700. The planning module showed that three two-man patrol units would be required to handle the calls for service. Previously, these districts had four two-man units and one one-man unit. Thus, there was a reduction allowing two units to be permanently assigned to preventive patrol. The patrol force was thus functionally divided into units which predominantly answered calls and other units which performed preventive patrol.

Results of the first experiment can be measured in two ways. First, the average travel time required in responding to a call fell from five minutes prior to the experiment to four minutes afterwards and, second, the arrangement was retained and is still in use today.

The second experiment began in October 1973 in two more districts between the hours of 2200 and 0700. As in the first experiment, the number of units was reduced from five to three with a functional split between call-for-service units and preventive patrol units. In this case the average travel time remained about the same. The new system is likewise still in use today.

Finally, as a result of these experiments, a recommendation has been made to permanently combine the two pairs of districts, thus decreasing the number of districts in the city from seven to five. It is anticipated that this recommendation will be approved and implemented before the end of 1974. A new patrol plan for the five districts will then be established using the APIS Planning Module.

FUTURE PLANS

The Rotterdam Police Department now has the capability to evaluate and change its beat structure on a regular basis. Another major innovation which is a direct result of the planning experiments is the split of patrol function between call-for-service and preventive

activity. Success of the changes is obviously reflected in the decision to continue the new mode of operation.

The Planning Section is now in the conceptual design phase of a computer-assisted dispatch system called Politis. Politis will be a real-time computer system to aid in the dispatch function. One aspect of the Politis system will concern the positioning of call-for-service units with the aim of minimizing travel time to calls (particularly high priority calls) by locating units at strategic points. It is anticipated that the Uniform Bureau will implement the results of this procedure manually and that the procedure will later be included in the system.

The two other major cities of Amsterdam and The Hague have also expressed interest in developing a Planning Module. In both cases an APIS Planning Module is justified but considerable effort will be required to acquaint the personnel with data processing capabilities since these departments have had only a very limited exposure to computers. Dispatch tickets are presently not keypunched in either department.

Finally, there is an effort within the government to encourage other departments to develop files similar to AIV. In these cases a Planning Module is not justified but an analysis capability would prove beneficial. The city of Groningen is the most advanced of the cities outside the major three and is currently developing an AIV file using a local university computer. Several alternatives for duplicating this effort in other cities are currently under review by the government.

FOOTNOTES

[1]Like the majority of persons in the Netherlands, the two are conversant in English, French, and German, which greatly facilitated their initial task.

[2]For a very readable introduction to queuing theory, see Morse, 1958.

[3]In the shorthand of queuing theory, this is sometimes known as an M/M/C model with priorities.

[4]See Larson, 1972: chapters 2, 6.

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